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ABSTRACT

Local Education Agencies in New York State initiated measurement plans that collected reading and mathematics achievement data via criterion-referenced measures during fiscal 1974-75. These measures permitted districts to detect the areas of deficiencies and the approximate instructional levels where Elementary and Secondary Education Act Title I participants encountered such difficulties. Different objectives at one ability level or an objective at differing ability levels may be mastered at different rates by learners with varying intensities of deficiencies. Consequently, the data provide information leading to estimates of expections (success-related) associated with both the learners (who vary as to the magnitude of the deficiencies) and the difficulty of the objective. For example, district planners proposing mastery by 90 percent of the sixth grade participants on a third grade ability level objective are selecting an unreasonable goal when the data indicates that only 46 percent of similar participants were successful in the past. These reports, which are nominally achievement summaries, also provide program managers and subject matter specialists with an indication of what degree of achievement to expect and what areas may be most profitably addressed in short remedial treatments when such needs are identified. (Author/DSE)

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Topical Report Series 76-9 76-10

A Survey of ESEA, Title I Participants' Successful Performance in Criterion-Referenced Objectives

Reading and Mathematics

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The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Bureau of School and Categorical Programs Evaluation
Albany, New York 12234

Topical Report Series
76-9
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A Survey of ESEA, Title I Participants' Successful Performance in Criterion-Referenced Objectives

Reading and Mathematics

The University of the State of New York
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INTRODUCTION

Local Education Agencies (LEAs) initiated measurement plans that collected reading and mathematics achievement data via criterion-referenced measures during fiscal 1974-75. These measures permitted districts to detect the areas of deficiencies and the approximate instructional levels where Elementary and Secondary Education Act (ESEA), Title I participants encountered such difficulties.

The data in these reports deal largely with findings from treatments of less than three months. Different objectives at one ability level or an objective at differing ability levels may be mastered at different rates by learners with varying intensities of deficiencies. Consequently, the data provide information leading to estimates of expections (success-related) associated with both the learners (who vary as to the magnitude of the deficiencies) and the difficulty of the objective. For example, the question that asks what percentage of sixth grade learners addressing third grade mathematics performance objectives can reasonably be expected to master them, may be answered. District planners proposing mastery by 90 percent of the sixth grade participants on this third grade ability level objective are selecting an unreasonable goal based upon the data which indicate that about 46 percent of similar participants were successful in the past. In other words, the data in these reports serve not only as an effectiveness summary but also provide rough expectancy guidelines.

Districts may have a choice of objectives that need remedial attention. If the treatment is to be of limited duration, the districts might use expectancy tables to select those objectives that hold the most promise of being successfully achieved in the short period of treatment.

Consequently, reports such as these which are nominally achievement summaries, also provide program managers and subject matter specialists with an indication of what degree of achievement to expect and what areas may be most profitably addressed in short remedial treatments when such needs are identified.

OVERVIEW

These reports were prepared as a summary of ESEA, Title I participants' reading and mathematics performance as indicated by criterion-referenced tests.

Purpose of the Report

The data are presented so that both the mastery achievement and the magnitude of the deficiency by objective become apparent. The reports, while initially prepared for publics internal to the State Education Department, may also be of interest to local school districts, teacher training institutions, and social scientists.

Background of Criterion-Referenced Measures

During fiscal year 1973-74, the State pilot tested the concept and initial implementation phase of accepting cognitive measures or observations generated by criterion-referenced tests. These tests are composed of test items specific to pupil behavioral or performance objectives. Test publishers specify the number of items (for particular objectives) that is sufficient to conclude that an objective has been mastered by an individual pupil. An ESEA, Title I target youngster in the sixth grade might be addressing an objective ability ranked for the third grade. Out-of-level testing is not a major consideration in elementary grades (unlike norm-referenced testing on some devices) since objectives are addressed in a continuum of sequential difficulty. The initiation of criterion-referenced testing as an exploratory effort required (1) inquiry into selected concepts not common to norm-referenced testing, (2) investigation as to when such devices might be appropriate, (3) development of a means to aggregate data across districts and different devices and (4) a delineation of some limitations associated with the approach.

Differences in Conceptualization

A pupil's score taken from a norm-referenced test (where test items are selected upon their ability to discriminate between pupils) permits evaluators to assess a pupil's achievement relative to other pupils in the original norming population. Criterion-referenced test items do not contrast pupil's relative placement, but rather yield information as to whether a specific performance objective has been mastered. Usually there are several items that are associated with a single objective. In other words, the focus with criterion-referenced tests is on the achievement or mastery of a particular skill rather than on a pupil's relative position on a test in

reference to a norm.

Potential Situations for Applications

Remedial treatments of short duration and/or intensity (e.g., summer schools) typically are designed to address only a few behavioral objectives. Alternately, there are Title I treatments designed to serve highly transient populations (e.g., neglected youth, delinquents, pregnant teenage girls) where there would be a limited exposure to the supplementary activities. On other occasions where Federal monies are redistributed or released late in the regular school terms and a treatment may be extended to include new participants, the limited time allows only a narrow focus on selected skills. Similarly, since the concern in the measure is a performance objective in reference to a hierarchy of skills (not a norming population), criterion-referenced tests may be legitimately administered to groups of pupils not usually included in a norm-referenced standardization group. With criterion-referenced materials, local education agencies may confine the conduct of a pretreatment, interim, or posttreatment assessment to the objectives under consideration.

Population Parameters

The Federal government established an exact formula for the designation of attendance areas as economically disadvantaged. The need for an ESEA, Title I remedial mathematics treatment was established by the pupil's performance on an appropriate norm-referenced achievement test. Educationally disadvantaged pupils recorded as participating in treatments in grade intervals 1-3, 4-6, 7-9, and 10-12 were performing at instruction ability or performance ranks below their age/grade placement. The difference in grade placement and actual instructional rank contributes to the description of the magnitude of the reading and mathematics deficiencies surrounding the target population. The population discussed in these reports is confined to those English dominant pupils whose reading and mathematics achievement was assessed by criterion-referenced measurement devices in fiscal year 1974-75.

Procedure

Districts received from the State a mathematics taxonomy containing 59 criterion-referenced objectives in eight categories. A comparable set of 42 reading objectives in five categories were also made available to the districts. School district personnel had been permitted to select whichever standardized criterion-referenced system that appealed to them. Consequently, data were submitted by the LEA's to the State from several criterion-referenced devices. A survey of the most common commercially prepared systems as indicated in the applications had been conducted previously. From this survey,

an index of objectives common to the several systems was developed and included on the reporting form. The publisher's indication of the performance rank (difficulty level) was taken at face value as was the publisher's criterion for "mastery."

Data Collection and Tabulation

Criterion-referenced test data were submitted routinely with the final section of the 1974-75 ESEA, Title I District Evaluation Report. The LEA's reported the number of participants attempting the objective and the number failing the item at the time of pretesting. (For diagnostic purposes, districts had selected the objectives by level where they anticipated pupil failure).

The data for each objective at each instructional rank for each grade interval subpopulation across all districts employing criterion-referenced measures were tabulated and summarized. Appropriate percentage distributions were computed. The data tabled in each "Appendix" are the summaries of the numbers of pupils who mastered the objective and the percent of pupils who mastered the objective by abbreviated objective topic.

Limitations

Currently much of the behavioral assessment must be accepted strictly in terms of content validity, as opposed to more carefully defined validation techniques associated with norm-referenced achievement tests. In other words, the state of the art with criterion-referenced testing and objectives requires that the publishers' definitions of mastery as well as the sequencing and hierarchical arrangement of objectives be accepted on face validity until validated empirically.

Similarly, while criterion-referenced approaches yield data hitherto not available, some information traditionally available from test scores is lost. There are no grade equivalent units reported (or available) and grade equivalents have been the traditional index of achievement. (e.g., a grade equivalent score of 3.7 indicates that a pupil's test score is typical of the seventh month in the third grade). Additionally, the State elected to use objective mastery as the reporting unit. For example, mastery of an objective may have required a correct response on four out of five items for the objective. If a pupil correctly answered two out of five items, the pupil failed to indicate mastery and was granted no credit for partial knowledge.

The procedure required that districts submit number of participants for coded objectives. Routine operations for data collection, tabulation and presentation were conducted. The data, therefore, were subject to those limitations or errors (1) inherent in the commercially prepared system and (2) typical in transcription and manipulation.

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A Survey of ESEA, Title I Participants' Successful Performance in Criterion-Referenced Objectives

Reading

November 1976

The University of the State of New York
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ANALYSIS OF THE DATA

The Department divided the reading objectives into five categories: phonetic analysis, structural analysis, vocabulary, comprehension, and study skills. Each of the five categories was further divided into topics. One more division separated the tasks into four grade level groupings. Based on such separations the following was discovered.

A. The emphasis on reading objectives shifted from decoding (code breaking) skills in the early elementary grades to comprehension skills in the junior and senior high school.

B. Elementary pupils in grades 4 through 6 appeared to consist of two subpopulations. One of the subpopulations initially failed the same objectives that pupils in grades one through three had failed, while the other subpopulation failed the objectives normally associated with grades 4 through 6.

C. The junior and senior high school project participants were still having difficulty with objectives that would normally be attained by fifth grade students.

RECOMMENDATIONS

The suggestions presented here are based upon evaluative ideas which may go beyond the data.

1. The two educationally disadvantaged populations found in the later elementary grades may have needs of differing intensity. Those participants who are marginally disadvantaged (placed at a slightly lower ability level in contrast to grade placement) may simply need more exposure to the currently agreed upon stimuli. Such pupils may be learning at a slower rate, but are learning from the conventional approaches, nonetheless. Futher programming for such students may continue to reinforce present approaches if this is viewed as the most efficient means for accelerating individual learning rates. However, exposure to alternate approaches may prove more productive than continuing or intensifying present approaches.

The other subpopulation consists of a core of disadvantaged learners who are far below grade placement in terms of demonstrated ability. It appears that the remedial experience offered to them simply do not evoke the appropriate outcomes. The need for a different set of experiences may require that the subject matter and curriculum experts analyze the probable causes, symptoms, and other behavioral characteristics, related to the deficiencies and select more appropriate objectives and/or devise other teaching/learning approaches.

2. The data revealed that some objectives could be readily accomplished in the short session treatments. Reading and curriculum experts may wish to design or select specific leveled learning experiences for remedial use. Such objective-based program packages would be tied to defined behavioral objectives and measures, would specify or include the grade level span, materials needed, staffing patterns and probable exposure limits. Packages of this nature might carry automatic approval by the Program Office once the needs were established.

3. The extremely high failure rates (both at entry level and during treatment) encountered by junior and senior high pupils suggests that there are curriculum related difficulties at this ability level. Current research related to comprehension indicates that skills such as drawing conclusions, making inferences and establishing relationships are more closely related and complex than present instructional approaches assume them to be. These may need to be treated as a sequence of related skills and in more comprehensive series of activities. For example, drawing conclusions is a culminating outcome of a sequence of tasks; such as: locating details, determining relationships among details, predicting possible outcomes based on these relationships and substantiating predictions.

These skills in combination draw heavily on thinking processes inherent to logic and scientific investigation. Successful instruction may require concurrent exposure to them in other subject matter fields.

TECHNICAL APPENDIX

Regardless of the number of publishers involved in criterion-referenced test work, the major categories within the field of reading were isolated and tabulated. Thus, the tables in the technical appendix were designed to separate reading objectives by category and topic according to grade level. An illustration of a typical commercially prepared objective precedes each table so that the tabled data may be related to one of the behaviors sought by the measure.

Achievement Summary

Since each table carries a column entitled "Number Attempted," "Number" refers to the pupils who failed the pretest. The number under the "Number Passed" heading refers to the pupils who, having failed the objective at pretest, demonstrated mastery at the time of posttesting. Since "Percent Passed" refers to the pupils demonstrating mastery at the posttest divided by the number of pupils failing the objective at the pretest then, review of the percent passed in the posttest column may provide districts with an idea of what might be achieved or accomplished (with a high probability) in short duration treatments. The number failed would provide a diagnostic or needs assessment profile. Districts having learners with reading deficiencies similar to those in the tables may select objectives where a high percentage (over 60) demonstrated mastery on the posttest and would thereby increase the likelihood of achieving certain objectives in treatments of short duration.

Potential Use

From the tables, district staff might determine (1) the percent of similar disadvantaged learners that might be expected to master selected objectives for use in setting project expectations and (2) which objectives could be expected to be mastered in treatments of short duration. These intentions complement the main functions of criterion-referenced measures for diagnosis and assessment.

Participants in Grades One through Three

The program office policy of early intervention for the eradication of reading errors was reflected in the large numbers of participants from grades one through three. The remedial reading participants addressed skills placed by ability levels from kindergarten through performance level five.

Phonetic analysis: the rudimentary skills for some methodologies required for reading and printed work include a code breaking capacity. Phonetic analysis frequently relates a spoken sound to a letter or letter combination.

Objective No. 2105 Consonant Blends Level: 1 [1/]
Given a picture, the word for which has the initial blend missing, you will identify from a list, the correct initial blend to complete the word:

/ bl /.

System: Individualized Criterion Referenced Testing
Publisher: Education Development Corporation

The data in table 1 indicate that ability level 1 objectives dealing with single letter vowels received the greatest attention. Performance level 3 objectives attempting mastery of final consonants and blends were the least satisfactorily mastered in short treatments within the phonetic analysis category.

1/ Level as used in this context means: Test manufacturers placed criterion-referenced objectives in an ascending order of difficulty for each skill area within a content domain. An expirical order of difficulty was derived and the objectives were labeled to correspond to approximate grade placements for instructional purposes. Disadvantaged learners found in grade six often may be found working toward comprehension or computation objectives at instructional or performance rank three. Such sixth grade pupils would be working toward objectives normally pursued by third grade pupils.

Table 1

Phonetic Analysis
(Participants in Grades 1 through 3)

Objective Topic	Level K			Level 1		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Letter Recognition	7	2	29	684	518	76
Initial Consonants	23	12	52	646	524	81
Medial Consonants	14	0	0	90	63	70
Final Consonants & Blends	3	3	67	764	622	81
Consonant Blends	5	4	80	772	566	73
Vowels: Single Letters	6	2	33	1,128	671	59
Vowels: More than one Letter				405	339	84
Consonant Digraphs				289	242	84
Silent Consonants, Hard and Soft C and G				29	24	83
Rhyming Words				236	199	84

(Table 1 Continued):

Objective Topic	Level 2			Level 3			Level 4		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Letter Recognition	185	146	79	139	134	96	56	3	50
Initial Consonants	209	153	73	53	32	60			
Medial Consonants	62	38	61	24	19	79			
Final Consonants & Blends	184	138	75	931	326	35			
Consonant Blends	304	207	68	472	336	71			
Vowels: Single Letters	494	333	67	59	53	90	5	3	60
Vowels: More than one Letter	882	639	72	787	404	51	7	5	71
Consonant Digraphs	483	373	77	749	611	82			
Silent Consonants, Hard and Soft C and G	436	296	68	33	29	88			
Rhyming Words	335	234	70	30	8	27	28	12	43

Structural analysis: the knowledge of word composition and elementary sentence structure requires skills of analysis so that common elements (e.g., prefixes) when encountered may be detected and unfamiliar words decoded.

Objectives No. 2203 Endings Level: 6
Identify the correct plural form of a word (irregular, y word, or s word).

System: Individual Pupil Monitoring System
Publisher: Houghton Mifflin

Objectives involving word endings appeared most often (see table 2). Mastery by 60/80 percent of the remedial candidates appears as a reasonable estimate. Objectives addressing prefixes and suffixes were the second most popular items for remediation, although a mastery rate of only 55 to 65 percent was observed.

Table 2

Structural Analysis
(Participants in Grades One through Three)

Objective Topic	Level 1			Level 2			Level 3		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Compound Words	249	204	82	215	144	67	25	13	52
Contractions	222	129	58	519	119	75	16	12	75
Endings	392	274	70	466	275	59	215	181	84
Prefixes, Suffixes, Affixes	323	186	56	348	227	65	82	54	66
Syllables	111	40	36	171	111	65	44	30	68
Prepositions, Phrases	37	25	68	108	64	59	11	2	18
Sentence Structure	56	22	39	12	6	50			
Punctuation	13	8	62				9	6	67

Vocabulary: such skills as the recognition of words for general meaning, similar sounds, opposites in relation to other words, or similarity in connotation are required independently even before the eventual interpretation within the context of textural narrative.

Objective No. 2304 Synonyms Level: 3
The student will demonstrate an understanding of synonyms by saying or writing one for each word spoken by the teacher.

System: SCORE
Publisher: Westinghouse Learning Corporation

Objective No. 2305 Word Meaning Level B (includes GR.3)
The student will define words in isolation by matching certain words with their definitions (word definition in isolation).

System: Prescriptive Reading Inventory
Publisher: CTB/McGraw-Hill, Inc.

Word meaning vocabulary skills continue to pose one of the most frequently selected problem areas and also one of the most persistent problem areas when addressed. The problems may involve the failure of participants to recognize more than one meaning for a word.

The data in table 3 indicate that objectives for antonyms and synonyms are also often selected for remediation but that mastery by over 65 percent in short treatments is unlikely.

Table 3

Vocabulary
(Participants in Grades One through Three)

Objective Topic	Level 1			Level 2			Level 3		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Antonyms	149	142	95	199	147	74	23	19	83
Homographs	4	4	100	149	93	62	18	13	72
Homonyms	66	59	89	126	111	88	24	22	92
Synonyms	113	99	88	199	131	66	13	13	100
Word Meaning	143	129	90	306	218	71	93	56	60
Heteronyms				27	8	30			

Comprehension: involving the subskills of reading is developed to support the capacity of the reader to detect the literal and/or inferential meaning of the printed paragraph. Understanding that which is read is a culmination of several constellations of subskills applied to narrative text.

Objective No. 24 Main Idea Level: 5
The student will demonstrate his ability to understand the main idea of a printed paragraph by selecting, from a set of printed choices, a sentence that states the main idea of the paragraph and should be placed at the beginning of the paragraph.

System: Fountain Valley Teacher Support System in Reading

Publisher: Richard L. Zweig, Associate, Inc.

As illustrated in table 4, objectives for identifying facts and details were most popular both across the ability level span and within single ability level (i.e., level 3). The across level range of mastery was 60 to 70 percent, with 60 percent mastery demonstrated at ability level 3.

Table 4
Comprehension
(Participants in Grades One through Three)

Objective Topic	Level 1			Level 2			Level 3		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Fantasy & Reality	11	9	82	76	66	84			
Classifying	25	11	44	164	110	67	12	3	25
Inferences, Cause or Effect	131	93	71	223	148	66	734	470	64
Facts & Details	221	157	71	363	230	63	823	502	61
Following Directions	105	82	78	102	79	77	14	10	71
Main Ideas	326	234	72	489	300	61	105	56	53
Picture Clues	45	33	73	42	33	79	4	3	75
Drawing Conclusions	139	103	74	161	122	76	724	466	64
Sequence	237	142	60	274	210	77	70	44	63
Literary Forms				13	13	100			
Author's Purpose and Techniques				9	6	67			
Setting and Character Analysis	38	15	39	31	16	52	26	16	62

Study Skills: are the user skills for the several types of vehicles of printed matter. Referencing materials are organized consistently according to a pattern specific to the variety of the source involved. Pupils are taught the organizational assembly so that the tools of referenced knowledge may be accessible to them.

Objective No. 2503 Aids: References, Footnotes, Bibliography Level: E

The child will locate a topic in response to a SEE reference (e.g., having located "Mohawk Indians See Iroquois Indians," the child locates the topic).

System: The Wisconsin Reading Design
Publisher: Interpreted Scoring Systems

At this ability level span, the skills reported in table 5 involve indexing, alphabetizing, and extracting information from the tables of contents. Such skills were mastered by nearly 80 percent of the participants attempting the objectives.

Table 5

Study Skills
(Participants in Grades One through Three)

Objective Topic	Level 2		
	Number Attempted	Number Passed	% Passed
Titles, Table of Contents	175	136	78

Participants in grades one through three were most often attempting objectives at the early phonics or code breaking ability levels. Objectives involving word meaning (within the vocabulary category) and detecting the main idea (under comprehension) posed frequent obstacles prior to treatment. Generally, among the participants diagnosed as deficient on objectives in any one of the three ability levels, about 60 percent or better could be expected to demonstrate mastery at the conclusion.

Participants in Grades Four through Six

The target population in grades 4 through 6 appeared to be divided into several subpopulations. One group's growth appeared to be arrested at the most elementary ability level of code breaking skills. A larger cluster of participants appeared to have halted progress at about level three of word meaning skills. Further, a substantial group of remedial reading candidates was found to have failed level five comprehension skills, especially with respect to objectives directed at main ideas and facts.

Phonetic analysis: the data in table 6 indicate a bimodal distribution with pupils clustering at ability levels two and five. Vowels, especially vowels with more than one letter, received a great deal of attention in remedial treatments.

The large number of participants addressing sixth grade performance level objectives suggests that some participants are only marginally disadvantaged in contrast to the participants found at ability levels below three.

Ability level three structural analysis skills involving compound words and syllables received the greatest attention. The mastery rates were roughly 70 percent for each of these objectives. Syllables objectives appears again at ability level six, but the mastery rate drops to 48 percent at the higher performance level according to the data in table 7.

Table 6

Phonetic Analysis
(Participants in Grades Four through Six)

Objective Topic	Level 1			Level 2			Level 3		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Letter Recognition				3	3	100	5	5	100
Initial Consonants	185	156	84	2	2	100	19	16	84
Medial Consonants				1	1	100	33	29	88
Final Consonants and Blends	172	115	67	77	55	71	141	124	88
Consonant Blends	177	111	63	284	155	55			
Vowels: Single Letters	229	161	70	150	105	70	77	60	78
Vowels: More than One Letter	157	127	81	284	214	75	116	82	71
Consonant Digraphs	20	16	90	115	88	77	117	94	80
Silent Consonants, Hard and Soft C and G				96	88	92	96	74	77
Rhyming Words	5	5	100	83	54	65	65	39	26

(Table 6 Continued):

Objective Topic	Level 4			Level 5			Level 6		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Letter Recognition	9	7	78				60	39	65
Initial Consonants	41	36	88	186	168	90			
Medial Consonants	27	24	89	51	38	75			
Final Consonants and Blends	22	20	91	394	190	48			
Consonant Blends	60	53	88	85	63	74	2	2	100
Vowels: Single Letters	73	50	68	179	91	51	326	118	36
Vowels: More than One Letter	427	130	30	329	216	66	375	149	50
Consonant Digraphs	52	45	87	105	64	61	329	119	37
Silent Consonants, Hard and Soft C and G	123	83	67	55	46	84	8	7	88
Rhyming Words	19	11	58	20	16	80	6	4	67

19

Table 7

Structural Analysis
(Participants in Grades Four through Six)

Objective Topic	Level 1			Level 2			Level 3		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Compound Words	166	48	29	20	9	45	703	491	70
Contractions	160	41	26	86	72	84	17	11	65
Endings	165	41	25	149	129	87	66	49	74
Prefixes, Suffixes, Affixes	136	25	18	88	65	74	108	96	89
Syllables	133	23	17	33	25	76	669	461	69
Prepositions, Phrases				21	13	62			
Sentence Structure	16	5	31	18	9	50	9	9	100
Punctuation				8	6	75	3	3	100

Table 7 (Continued):

Objective Topic	Level 4			Level 5			Level 6		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Compound Words	81	50	62	87	70	80	2	1	50
Contractions	76	43	57	8	8	100			
Endings	65	38	58	139	91	65	6	5	83
Prefixes, Suffixes, Affixes	57	44	77	134	82	61	57	31	54
Syllables	46	20	43	219	144	66	395	188	48
Prepositions, Phrases	37	24	65	18	9	50	10	3	30
Sentence Structure	62	27	44	54	33	61	12	5	42
Punctuation	67	33	49	94	37	39			

Vocabulary: These skills objectives provided obstacles most acutely at performance levels three and five. Word meaning problems often occurred when learners were unable to recognize multiple meanings for the same word or when learners would know the meaning of a word when it was presented orally but failed to recognize the configuration in print. Success was indicated by less than 50 percent of the remedial reading participants in the treatments of short duration (see table 8).

Comprehension: The objectives data in table 9 indicate that over 1,000 participants were unable to understand main ideas in material prepared for ability levels five and less. Where main ideas are not understood the participants were not likely to be able to draw conclusions, a notion confirmed by the high numbers of participants also addressing those skills. The percent of pupils demonstrating mastery of comprehension skills varied from 10 to 100 percent without a consistent pattern by objective topic or level.

Table 8

Vocabulary
(Participants in Grades Four through Six)

Objective Topic	Level 1			Level 2			Level 3		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Antonyms	9	4	44	20	9	45	185	165	89
Homographs				6	5	83	125	119	95
Homonyms	23	17	74	64	51	80	171	163	95
Synonyms				23	19	83	124	107	86
Word Meaning	5	5	100	72	48	67	1,239	575	46
Heteronyms				31	30	97	51	40	78

Table 8 Con't on next page

Table 8 (Continued):

Objective Topic	Level 4			Level 5			Level 6		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Antonyms	29	27	93	284	128	47	13	7	54
Homographs	44	38	86		55	67	17	12	71
Homonyms	5	1	20		105	45			
Synonyms	65	34	52	314	166	53			
Word Meaning	178	142	80	598	259	43	420	124	30
Heteronyms	16	11	69						

Table 9
Comprehension
(Participants in Grades Four through Six)

Objective Topic	Level 1			Level 2			Level 3		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Fantasy and Reality				39	24	62	28	20	71
Classifying				25	20	80	61	50	82
Inferences, Cause or Effect	45	25	56	68	54	79	213	181	85
Facts and Details	41	24	59	65	58	89	249	145	58
Following Directions				17	10	59	69	41	59
Main Ideas	35	15	43	135	94	70	186	137	74
Picture Clues				38	28	74	59	40	68
Drawing Conclusions	27	25	93	170	124	73	150	126	84
Sequence				128	92	72	98	86	88
Literary Forms				8	7	88			
Author's Purpose and Techniques				93	52	56			
Setting and Character Analysis	57	39	68	88	49	56	21	10	48

Table 9 is continued on next page.

Table 9 (Continued)

Comprehension
(Participants in Grades Four through Six)

Objective Topic	Level 4			Level 5			Level 6		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Fantasy and Reality	40	29	73	248	84	34	10	1	10
Classifying	93	59	63	257	155	60	10	5	50
Inferences, Cause or Effect	274	106	39	337	173	51	79	48	61
Facts and Details	311	132	42	560	357	64	26	8	31
Following Directions	104	66	63	218	80	37			
Main Ideas	277	182	66	452	223	49	47	17	36
Picture Clues				98	51	52	14	10	21
Drawing Conclusions	391	193	49	216	136	63	31	25	81
Sequence	218	89	41	323	180	56	77	43	56
Literary Forms	4	4	100	151	28	19			
Author's Purpose and Techniques	5	4	80	333	78	23	23	9	39
Setting and Character Analysis	147	35	24	685	129	19	21	8	38

Study Skills: At no level did the number of participants attempting an individual study skills objective exceed 100. The data in table 10 reveal that the objectives dealing with the mechanics of locating information may be relatively easily achieved but that the extraction of the main points of information from the source, especially at ability level five, was not so easily accomplished.

Table 10

Study Skills
(Participants in Grades Four through Six)

Objective Topic	Level 2			Level 3		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Titles, Table of Contents	11	9	82	55	54	98
Aids: Visual, Tabular	9	9	100	52	48	92
Aids: References, Footnotes, Bibliography	6	5	83			
Selection of Information from Sources	48	31	65	45	37	82
Presentation of Text Material	10	7	70			
Summary, Outline	6	6	100			

Table 10 (Continued):

Objective Topic	Level 4			Level 5		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Titles, Table of Contents	21	20	95	71	32	45
Aids: Visual, Tabular	22	20	91	33	9	27
Aids: References, Footnotes, Bibliography	6	5	83	33	17	52
Selection of Information from Sources				21	4	19
Presentation of Text Material						
Summary, Outline				19	5	26

The target population placed in grades four through six were engaged with ability level objectives spanning performance levels one through six. The data revealed district clusters of pupils at the early elementary ability levels and again at the upper end of the later elementary levels.

Participants in Grades Seven through Nine

A pattern of objectives most frequently attempted emerged at ability levels five and six (these same objectives also posed obstacles for the high school participants). A distinct subpopulation found to be performing at the lowest ability levels in comprehension skills remained.

Phonetic analysis: Few participants were involved with code breaking phonetic analysis skills. The data in table 11 reveal that 14 of the 17 objectives attempted were mastered by over 50 percent of the participants attempting them in short duration treatments.

Table 11

Phonetic Analysis
(Participants in Grades Seven through Nine)

Objective Topic	Level 2			Level 3		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Initial Consonants						
Medial Consonants						
Final Consonants and Blends						
Consonant Blends						
Vowels: Single Letters				3	3	100
Vowels: More than One Letter	11	10	90	6	3	50
Consonant Digraphs						
Silent Consonants, Hard & Soft C & G						
Rhyming Words						

Table 11 (Continued):

Objective Topic	Level 4			Level 5			Level 6		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Initial Consonants				25	14	56			
Medial Consonants				70	38	54	4	2	50
Final Consonants and Blends							22	9	41
Consonant Blends				61	55	90	15	11	73
Vowels: Single Letters				45	29	64	3	3	100
Vowels: More than One Letter	10	10	100	37	23	62	14	14	100
Consonant Digraphs							7	4	57
Silent Consonants, Hard & Soft C & G							3	3	100
Rhyming Words							8	7	88

Structural analysis: Prefixes and suffixes at ability levels five and six, among the structural skills, received the greatest attention. Nearly 80 percent of those pupils attempting level five objectives demonstrated mastery, although the success rate fell to 33 percent mastery at level six (see table 12).

Table 12

Structural Analysis
(Participants in Grades Seven through Nine)

Objective Topic	Level 1			Level 2		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Compound Words						
Contractions						
Endings	3	2	67			
Prefixes, Suffixes, Affixes						
Syllables				12	9	75
Sentence Structure						
Punctuation						

Table 12 (Continued):

Objective Topic	Level 3			Level 4		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Compound Words				9	3	33
Contractions	53	34	64	18	13	72
Endings	29	15	58	204	74	36
Prefixes, Suffixes, Affixes	112	89	79	149	49	33
Syllables	87	76	87	11	4	36
Sentence Structure	28	8	29	18	12	67
Punctuation	4	1	25	19	7	37

Vocabulary: Objectives involving word meaning and synonyms were those vocabulary skills most frequently attempted. The data in table 13 indicate (from mastery rates of 19 and 20 percent) that word meaning and synonyms are persistent problems not easily addressed in short treatments.

Table 13

Vocabulary
(Participants in Grades Seven through Nine)

Objective Topic	Level 2			Level 3			Level 4		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Antonyms	28	14	50	73	44	60			
Homographs				37	27	73	19	8	42
Homonyms	24	18	75	32	24	75	17	6	35
Synonyms	28	14	50	355	72	20	20	10	50
Word Meaning				472	89	19	43	33	77
Heteronyms				12	10	83	19	8	42

Comprehension: The greatest number of remedial reading participants were found attempting comprehension skills. Two populations emerged. One subpopulation consisted of a group of pupils in grades 7 through 9 performing at the lowest possible level of comprehension skills. In contrast to this core of educationally disadvantaged was a population of remedial readers attempting objectives at levels five and six. The data in table 14 indicate that the largest single number of pupils were attempting to derive inferences and cause and effect relationships. Since less than a third of the participants (cumulatively) were successful, such objectives may not constitute particularly efficient choices for short-term remedial sessions. Objectives addressing facts, details, main ideas, and sequence continue to pose obstacles, with mastery rates seldom exceeding 50 percent of the participants attempting them.

Table 14

Comprehension
(Participants in Grades Seven through Nine)

Objective Topic	Level 1			Level 2			Level 3		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Fantasy and Reality	33	10	30						
Classifying	36	20	56						
Inferences, Cause or Effect	107	40	37				101	41	41
Facts and Details	166	66	40						
Following Directions									
Main Ideas	80	15	19	7	6	86	90	36	40
Picture Clues									
Drawing Conclusions	77	10	13	6	5	83.3	121	40	33
Sequence	145	43	30	2	2	100	106	32	30
Literary Forms	101	40	40						
Author's Purpose and Techniques									
Setting and Character Analysis	34	21	62						

Table 14 continued on next page

Table 14 (Continued):

Objective Topic	Level 5			Level 6		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Fantasy and Reality	103	78	76	16	10	63
Classifying	53	43	81	13	5	38
Inferences, Cause or Effect	382	91	24	216	75	35
Facts and Details	294	119	40	195	73	37
Following Directions				15	6	40
Main Ideas	294	113	38	25	12	48
Picture Clues	23	12	52	11	8	73
Drawing Conclusions	89	42	50	17	8	47
Sequence	189	91	48	36	19	52
Literary Forms	95	7	7	19	10	53
Author's Purpose and Techniques	73	55	75	17	3	18
Setting and Character Analysis				18	5	28

Table 14 (Continued):

Objective Topic	Level 7			Level 8		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Fantasy and Reality						
Classifying						
Inferences, Cause or Effect						
Facts and Details						
Following Directions				78	77	99
Main Ideas						
Picture Clues						
Drawing Conclusions						
Sequence						
Literary Forms						
Author's Purpose and Techniques	64	59	92			
Setting and Character Analysis						

Study Skills: The two most frequently attempted objectives within the study skills category were level five use of visual and tabular aids and the ability to select information from the resources. The data in table 15 indicate that junior high participants lack skills in (1) using resources to locate where information is located (library skills) and (2) extracting the desired information once it is located. The finding is not surprising considering the disclosed difficulties with the comprehension skills of facts and details and main ideas.

Table 15

Study Skills
(Participants in Grades Seven through Nine)

Objective Topic	Level 1			Level 2		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Aids: Visual, Tabular						
Aids: References, Footnotes, Bibliography	69	43	62	171	77	45
Selection of Information from Sources						
Presentation of Text Material	15	7	47			

Table 15 (Continued):

Objective Topic	Level 5			Level 6		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Aids: Visual, Tabular	239	105	44			
Aids: References, Footnotes, Bibliography	66	30	45			
Selection of Information from Sources	340	49	14	27	19	70
Presentation of Text Material	38	24	63			

The target population in grades seven through nine generally encountered the greatest problems at ability levels five and six. A small core of disadvantaged learners was still addressing the most elementary comprehension skills. Limited vocabulary recognition (in print) cannot help but contribute to difficulties in the comprehension skills. Each of these deficiencies was probably reflected in the obstacles encountered with the skills required to extract information from standard library references.

Participants in Grades Ten through Twelve

The profile of the senior high students was similar to that for the junior high participants.

Phonetic analysis: Few students were addressing behavioral objectives in the category of phonetic analysis (see table 16) or structural analysis (see table 17). Ability level five appeared to be the greatest hurdle for the disadvantaged learners. Most commercially prepared criterion-referenced objectives terminate with the eighth grade ability levels, a conventional level used as a minimum reading competence indicator. Since level five objectives fall at least three ability levels below minimum competence and at an even greater distance from the age/grade placement of the actual participants, there is cause for serious concern for these remedial reading pupils.

Table 16

Phonetic Analysis
(Participants in Grades Ten through Twelve)

Objective Topic	Level 5		
	Number Attempted	Number Passed	% Passed
Final Consonants and Blends	32	29	91
Consonant Blends	34	27	79
Vowels: Single Letters	22	16	73
Consonant Digraphs	8	5	63
Silent Consonants, Hard & Soft C & G	18	9	50

Structural analysis: Even though the participants numbers are small, mastery of the topics is relatively high,

Table 17

Structural Analysis
(Participants in Grades Ten through Twelve)

Objective Topic	Level 4			Level 5		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Compound Words				14	10	71
Contractions				39	32	82
Endings	2	2	100	18	14	78
Prefixes, Suffixes, Affixes				69	52	75
Syllables	1	1	100	52	32	62

Vocabulary: The vocabulary skills involving word meaning and synonyms continued to provide difficulties for the target population. The data in table 18 indicate that mastery was achieved by 47 and 59 percent, respectively, in the short duration treatments.

Table 18

Vocabulary
(Participants in Grades Ten through Twelve)

Objective Topic	Level 5		
	Number Attempted	Number Passed	% Passed
Antonyms	32	22	69
Homonyms	11	6	55
Synonyms	137	65	47
Word Meaning	112	66	59

Comprehension: Developing inferences, relating causes and effects, and recalling facts and details were the most problematic comprehension objectives. The data in table 19 reveal that these two objectives were the least satisfactorily mastered in the level five series.

Table 19

Comprehension
(Participants in Grades Ten through Twelve)

Objective Topic	Level 4			Level 5		
	Number Attempted	Number Passed	% Passed	Number Attempted	Number Passed	% Passed
Fantasy and Reality				49	21	43
Classifying	20	1	5	59	35	59
Inferences, Cause or Effect				318	47	15
Facts and Details	2	2	100	228	68	30
Following Directions				19	15	79
Main Ideas	6	3	50	95	51	54
Picture Clues				12	8	67
Drawing Conclusions				41	24	59
Sequence	7	6	86	83	42	51
Literary Forms				6	4	67

Study skills: The skill most frequently addressed involved extracting information from the library resources. The mastery rate according to the data in table 20 was just 40 percent after treatment.

Table 20

Study Skills
(Participants in Grades Ten through Twelve)

Objective Topic	Level 5		
	Number Attempted	Number Passed	% Passed
Titles, Table of Contents	23	22	96
Aids: Visual, Tabular	8	5	63
Aids: References Footnotes, Bibliography	30	24	80
Selection of Information from Sources	166	67	40
Presentation of Text Material	53	19	36
Summary, Outline	25	23	92

The senior high school target population seemed unable to draw inferences from material read, recall or recognize facts and details, or identify the meaning of words commonly found in print for a public meeting, an eighth grade literacy requirement.

While participating in ESEA, Title I-sponsored remedial treatments, disadvantaged learners mastered objectives that had been failed prior to treatment. Mastery of selected objectives does not mean that a target pupil is currently "on grade level" with respect to reading as well as his or her more advantaged peers. Rather, the accomplishment of specific behavioral objectives, as measured by criterion-referenced tests material, indicates that a pupil mastered a skill, usually anticipated as having been mastered one to two years earlier in his educational development, while participating in an ESEA, Title I supplementary treatment. The disadvantaged learners have moved up the ladder in the hierarchy of skills beyond where they previously may have stalled without the supplementary instruction.

Topical Report Series
76-10

A Survey of ESEA, Title I Participants' Successful Performance on Mathematics Criterion-Referenced Objectives After Treatment

July 1976

The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Bureau of School and Categorical Programs Evaluation
Albany, New York 12234

ANALYSIS OF THE DATA

A review of the most frequently attempted objectives for grade intervals 1-3, 4-6, 7-9, and 10-12 was undertaken. The Department divided the mathemtics objectives into eight categories: number and operations, geometry, measurement, sets, analysis, application, and problem solving, functions and graphs, logical thinking, and statistics and probability. Each of the eight categories was further divided into topics. One more division separated the task into four grade level groupings. Based on such separations, the following was discovered.

Participants in grades 1-3. Two groups of disadvantaged learners emerged. One group attended to rudimentary number fact objectives involving number seriation, and magnitude while the other group attempted simple addition and subtraction objectives. District administrators attempting preoperational objectives may expect 70 to 85 percent mastery although the mastery rate on the operations (computation) objectives dropped to 50 to 80 percent. Fewer than 100 participants in any given level were detected as addressing skills associated with geometry, measurement, set theory, and problem solving.

Participants in grades 4-6. Again, two groups of disadvantaged mathematics participants emerged. One group was found at levels 2 and 3 concentrating upon addition, subtraction, multiplication, and dividion as well as comined operations. The success rate for mastery ranged between 40 and 85 percent. The second group, operating at levels 5 and 6 on the same objective topics, demonstrated approximately the same success rate. Considerable difficulty began to appear with properties and operations of fractions although 60 to 70 percent of the participants attempting such objectives were successful. Little attention was directed at geometry, sets, functions and graphs or applications.

Participants in grades 7-9. Participants at grade placement 7 through 9 most often were attempting objectives at performance levels 5 and 6. Where the participants numbered over 100 at these performance levels, the success rate was never greated than 65 percent mastery and usually below 50 percent mastery. Interest in geometric properties was detected at level 7, although mastery was achieved by just over one-third of the participants receiving remedial instruction. Concepts and operations involving fractions, percentages, and decimals were popular objectives at ability levels 2 through 8, although success (mastery) rates ranged between 23 and 73 percent.

Participants in grades 10-12. Few participants were attempting criterion-referenced objective topics. Performance level 7 computation (especially division) skills were most popular. The success rates (ranging from 63 to 75 percent) were encouraging, although it should be noted that this high school target puplation has not yet met the eighth grade minimum competency skills required for graduation. Objectives involving decimals and percentages continued to need remedial attention by some high school pupils.

Mastery of selected objectives did not mean that a target pupil caught up to grade level with respect to mathematics performance. Rather, the accomplishment of specific behavioral objectives as measured by criterion referenced test material indicated that a pupil mastered skills, usually mastered one to two years earlier by his/her more advantaged peers. While participating in ESEA, Title I supplementary treatments, disadvantaged learners moved up in the hierarchy of skills beyond where they stalled previously.

The elementary school population (grades 1-6) appeared to consist of two subpopulations based upon isolated deficiencies. One population attempted the rudimentary concepts of quantity, seriation, and number lines. This condition was particulary alarming for participants located by age/grade placement in grades 4 through 6. Mastery rates ranged from 40 to 85 percent. A second group of "marginally" disadvantaged participants concentrated more on age old computation skills of addition, subtraction, multiplication and division. Usually, mastery by this population varied between 50 and 80 percent across treatments of short duration. Skills involving decimals, fractions, and percentages received greater emphasis as the participants reached the later elementary grades.

The junior and senior high school population also concentrated on basic computation skills with clustering at levels 5 and 7. Operations involving division proved to be the objectives most often pursued by the senior high population.

Across all grades, few participants attempted objectives involving geometry, measurement, statics, or logic. Only limited attention was directed toward problem solving where reading skills sometimes confound the measures.

It was unclear as to why the two subpopulations identified in the elementary grades disappeared at the junior and senior high levels. Perhaps the lower performing group withdrew from formal education upon reaching the minimum age. The surviving population at this level tended to be distributed across objectives at performance levels at least two years below where the age of the participants would suggest placement. This target population had not yet demonstrated mastery of the basic computation skills required for certified eighth grade competency.

RECOMMENDATIONS

The following recommendations are derived from inferences going beyond the data. The suggestions are neither exhaustive nor ranked by importance as presented below.

1. The two educationally disadvantaged populations found in the elementary grades may have needs of differing intensity. Those participants that are marginally disadvantaged (placed at a slightly lower ability level in contrast to grade placement) may simply need more exposure to the currently agreed upon stimuli. Such pupils may be learning at a slower rate, but are learning from the conventional approaches, none-the-less. In other words, more of the same may be beneficial for such participants.

   The other subpopulation consists of a core of disadvantaged learners who are far below grade placement in terms of demonstrated ability. It appears that the stimuli presented simply do not evoke the appropriate responses. The need for a different set of stimuli may require that the subject matter and curriculum experts analyze the probable causes, symptoms and other behavioral characteristics, bearing on the deficiencies and devise other approaches to accomplish the same objectives.

2. The data revealed that some objectives could be readily accomplished in the short session treatments. Mathematics and curriculum experts may wish to design specific leveled learning packages for remedial use. Such packages would be tied to delineated behavioral objectives and measures, and would specify or include the station requirements, materials needed, staffing patterns and probable exposure limits.

3. The most frequently addressed objectives at level 6 by junior high participants consistently were not mastered by more than 65 percent of those pupils attempting them. Mathematics curriculum experts at all levels may need to develop alternate stimuli or approaches to provide the conditions for mastery by greater numbers of remedial mathematics participants.

APPENDIX

The following tables were designed to separate mathematics objectives by category and topic according to grade level. An illustration of typical commerically prepared objective precedes each table so that the tabled data may be related to one of the behaviors sought by the measure. Each table carries a column entitled "Number Failed." "Number" refers to the pupils who failed the pretest. The number under the "Number Passed" heading refers to the pupils who, having failed the objective at pretest, demonstrating mastery at the time of posttesting. "Percent Passed" refers to the pupils demonstrating mastery at the posttest divided by the number of pupils failing the objective at the pretest. A review of the percent passed on the posttest column may provide districts with an idea of what might be accomplished (with a high probability) in short duration treatments. The number failed would provide a diagnostic or needs assessment profile. Districts having learners with mathematics deficiencies similar to those in the tables select objectives where a high percentage (over 60) demonstrated mastery on the posttest and thereby increase the likelihood of achieveing certain objectives in treatments of short duration.

From the tables, interested district staff might determine (1) the percent of similar disadvantaged learners who might be expected to master selected objectives for use in setting project expectations and (2) which objectives could be expected to be mastered in treatments of short duration. These intentions complement the main functions of criterion-referenced measures for diagnosis and assessment.

Participants in Grades One Through Three

Criterion-referenced test items (tied to behavioral objectives) were administered to participants at the outset of the remedial treatments and were readministered during the treatments when the teachers felt that the students could demonstrate mastery. Based upon the eligibility process, the ability level 2 skills received the greatest attention.

Numbers and operations, the introductory concepts of quality, number lines, number facts, and simple operations are usually taught in the early elementary grades. The data in table 1 reveal that preoperational concepts (i.e., seriation) were focal for part of the target population, but that simple addition and subtraction objectives were the most frequently addressed. A district administrator setting expectations for the participants attempting preoperational concepts might hope for a 70 to 85 percent rate of mastery; while those pupils attempting simple computation objectives

might realize between 50 and 80 percent mastery.

Objective No. 1108 Subtraction: Concepts and Skills Level: 2 [1]

Given a subtraction problem, the student will be able to find the difference and check the solution (whole number sums to 18).

System: Individual Mathematics System
Publisher: Ginn and Company

Table 1
Numbers and Operations
(Mathematics Participants in Grades One Through Three)

Objective Topic	Level 1			Level 2			Level 3			
	No. Fail	No. Pass	% Pass	No. Fail	No. Pass	% Pass	No. Fail	No. Pass	% Pass	
Pre-operational Concepts: Equivalence, Equality, Number, Fewer, More, Etc.	120	100	83	149	101	68	476	328	69	
Whole Numbers	74	56	76	82	65	79	24	10	42	
Fractions (Positive Rationale Numbers & Zero	75	41	55	63	37	59	33	24	73	
Decimals							21	12	57	
Real Number System	24	13	54	11	6	55				
Addition: Concepts/Skills	156	106	68	803	630	78	111	62	56	
Subtraction: Concepts/Skills	151	96	64	731	554	76	101	58	57	
Multiplication: Concepts/Skills	6	3	50	320	215	67	57	34	60	
Division: Concepts/Skills	7	5	71	102	40	39	47	24	51	
Properties of Operations and Relations	87	33	38	73	60	82	8	3	38	
Numeration Systems	7	5	71	14	8	57	8	5	63	
Number Sentences	38	32	84	152	102	67	41	23	56	
Number Theory				35	25	71				
Estimation, Rounding	8	0	0	12	5	42				
Mathematics: Numbers/Operations	7	6	86							

[1] Level as used in this context means: Test manufacturers placed criterion-referenced objectives in an ascending order of difficulty for each skill area within a content domain. An empirical order of difficulty was derived and the objectives were labeled to correspond to approximate grade placements for instructional purposes. Disadvantaged learners found in grade six often may be found working toward comprehension or computation objectives at instructional or performance rank three. Such sixth grade pupils would be working toward objectives normally pursued by third grade pupils.

Geometric spatial relationships including planer and three dimensional representations are introduced early in the elementary child's mathematics development in a spiral fashion, often in alternate years. Few participants were addressing such objectives, and mastery rates ranged from 42 to 75 percent.

Objective No. 1205 Polygons: Triangles, Quadri- Level: 4
laterals, and
Others

The student will be able to identify geometric figures: triangle, rectangle, square and parralelogram.

System: Individual Pupil Montoring System
Publisher: Houghton Mifflin

Table 2

Geometry
(Mathematics Participants in Grades One Through Three)

Objective Topic	Level 1			Level 2			Level 3		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Points, Lines, Rays, Line Segments				18	12	67	12	5	42
Polygons: Triangles, Quadrilaterals, and others				4	3	75			
Congruence, Similarity, Ratio and Proportion	12	8	67	13	8	62	9	4	44
Circles				16	12	75			

Measurement, involving the mathematical concepts of scale, calibration, interval, etc., especially as they relate to temperature, time and money, received considerable remedial attention for the disadvantaged youngster.

The data in table 3 indicate that more than 50 percent of the participants at each ability level were successful in meeting the measurement objectives. (The highest success rate was achieved at ability level 4, a performance level that was not expected from educationally disadvantaged pupils in grades 1 through 3).

Objective No. 1305 Monetary Systems Level: 3
Given a set of coins, you will identify the total value of the set (quarters, dimes, nickles, and pennies).

System: Individualized Criterion Referenced Testing
Publisher: Educational Development Corporation

Table 3
Measurement
Mathematics Participants in Grades One Through Three

Objective Topic	Level 1			Level 2			Level 3			Level 4		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Non-standard Measures	47	37	79									
English System	69	52	75	37	22	59	25	20	80			
Monetary System	29	23	79	77	57	74	33	22	67			
Time and Date	62	43	69	39	27	69	13	7	54	21	17	81

Sets, the notions surrounding belonging, grouping, mutual exclusivity, union, matching, identity and intersection constitute complex abstractions. The capacity of perceiving such concepts is supportive of mathematical logic.

Objective No. 1603 Matching, Equivalence, Cardinal Numbers, Finite and Infinite Sets Level: 1

Given a set of objects you will identify the cardinal number of the set (to nine numbers).

System: Individualized Criterion-Referenced Testing
Publisher: Educational Development Corporation

The pupils achieved the most success with objectives revolving around identification, labeling, recognition and belonging within set theory. The data in table 4 indicate that the participants were quite successful (in excess of 85 percent achieved such objectives) with lower cognitive processes involving sets, but that when the solutions to problems were sought, the achievement dropped to less than 30 percent. Apparently, the target population could master the language of sets but was not overly successful in applying the definitions to problems.

Table 4

Sets
Mathematics Participants in Grades One Through Three

	Level 1			Level 2			Level 5		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Identification, Membership, Notation	50	45	90	77	69	87	35	35	100
Empty Set, Subset, Equal Sets, Disjoint Sets	41	30	73	5	4	80			
Matching, Equivalence, Cardinal Number, Finite and Infinite Sets	19	13	68				12	2	17
Solution for Equations and Inequalities				25	7	28			

Analysis, application, and problem solving, including the number facts learned as concepts and operations, are applied to the real problems in science, social studies, and personal business transactions. (The measures involve word problems and may be confounded by reading skills.)

The data in table 5 reveal that difficulties with word problems persist across short duration treatments. The success rate in mastery ranged from 40 to 70 percent.

Objective No. 1902 Solution of Problems Level: 7-8
The student will be able to solve a word problem involving the addition and division of whole numbers.

System: Prescriptive Mathematics Inventory (PMI)
Publisher: CTB/McGraw-Hill

Table 5

Analysis, Applications, and Problem Solving
Mathematics Participants in Grades 1 through 3

Objective Topic	Level 1			Level 2			Level 3		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Analysis of Problems	35	19	54	42	20	48			
Solution of Problems	41	29	71	64	30	61	34	13	38

Participants in Grades Four Through Six

The most frequently addressed objectives involved the basic operations of addition, subtraction, multiplication, and division. The performance ability levels for the objectives were clustered at 2-3 and 5-6. While the data suggest two subpopulations (one marginally disadvantaged and one severely disadvantaged), mastery rates beyond 60 percent were achieved by the participants except for level six objectives in these areas. Since only the category of numbers and operations contained substantial numbers of participants, a discussion of the findings for other categories is omitted for the sake of brevity. Tables 6 through 13 contain comparable data to that presented for participants in grades 1 through 3. Where categories are introduced that have not appeared before, illustrations of objectives are included. Generally, there is little hope of this population achieving objectives dealing with geometry or logic in short duration treatments.

Table 6

Numbers and Operations
(Mathematics Participants in Grades 4 Through 6)

Objective Topic	Level 1			Level 2			Level 3		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Pre-operational Concepts: Equivalence, Equality, Order, Number, Numeral, Fewer				28	16	57	211	86	41
Whole Numbers				27	14	52			
Fractions (i.e., Positive Rational Numbers and Zero				86	60	70			
Decimals				26	8	31			
Real Number System									
Addition: Concepts and Skills	16	16	100	190	160	84	1,681	1,116	66
Subtraction: Concepts and Skills	14	14	100	553	455	82	1,208	772	64
Multiplication: Concepts and Skills							1,696	1,155	68
Division: Concepts and Skills				437	326	75	1,430	732	51
Properties of Operations and Relations				1234	474	38			
Numeration Systems				39	12	31			
Number Sentences				67	58	86			
Number Theory				37	32	86			
Estimation, Rounding				13	4	31			
Percent				8	4	50			

Table 6 (Cont'd.)

Objective Topic	Level 4			Level 5			Level 6		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Pre-operational Concepts: Equivalence, Equality, Order, Number Numeral, Fewer	30	24	80	59	41	69	6	2	33
Whole Numbers	45	28	62	189	103	54	345	122	35
Fractions (i.e., Positive Rational Numbers and Zero	101	71	70	413	235	57	92	62	67
Decimals	3	3	100	175	99	56	39	23	59
Real Number System	5	5	100						
Addition: Concepts and Skills	70	54	77	177	148	84	417	179	43
Subtraction: Concepts and Skills	62	50	81	224	180	80	484	232	48
Multiplication: Concepts and Skills	712	562	79	103	61	59	533	258	48
Division: Concepts and Skills	157	90	57	413	278	67	539	249	46
Properties of Operations and Relations	42	36	86	73	37	51	5	3	60
Numeration Systems	18	9	50	101	49	48			
Number Sentences	36	22	61	62	38	61	4	2	50
Number Theory	17	13	76				2	2	100
Estimation, Rounding									
Percent									

Objective Topic	Level 7		
	Number Failed	Number Passed	Percent Passed
Pre-operational Concepts: Equivalence, Equality, Order, Number, Numeral, Fewer			
Whole Numbers			
Fractions (i.e., Positive Rational Numbers and Zero			
Decimals	14	13	93
Real Number System			
Addition: Concepts and Skills			
Subtraction: Concepts and Skills			
Multiplication: Concepts and Skills			
Division: Concepts and Skills			
Properties of Operations and Relations			
Numeration Systems			
Number Sentences			
Number Theory	35	9	26
Estimation, Rounding			
Percent			

Table 7

Geometry
Mathematics Pupils in Grades Four Through Six

Objective Topic	Level 2			Level 4			Level 5		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Points, Lines, Rays, Line Segments	26	26	100	25	4	16	28	15	54
Parallel and Perpendicular Lines							21	10	48
Regions, Planes, Space, Curves				24	4	17	47	15	32
Angles							39	9	23
Polygons: Triangles, Quadrilaterals, and others				24	4	17	69	22	32
Congruence, Similarity, Ratio and Proportion	5	4	80	46	16	35	50	12	24
Polyhedra: Prisms, Pyramids, and others							10	7	70
Spheres, Cylinders, Cones							14	14	100
Coordinate Geometry							8	8	100

Objective Topic	Level 6		
	Number Failed	Number Passed	Percent Passed
Points, Lines, Rays,Line Segments			
Parallel and Perpendicular Lines			
Regions, Planes, Space, Curves			
Angles			
Polygons: Triangles, Quadrilaterals, and others			
Congruence, Similarity, Radio and Proportion	9	4	44
Polyhedra: Prisms, Pyramids, and others			
Spheres, Cylinders, Cones			
Coordinate Geometry			

Table 8

Measurement
Mathematics Pupils in Grades Four Through Six

Objective Topic	Level 2			Level 3			Level 4		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Non-standard Measures									
English System	18	18	100				41	27	66
Metric System, including conversions							9	7	78
Temperature							17	11	65
Monetary System							21	15	71
Time and Date	28	10	36	10	5	50			
Metric-Geometry, Trigonometry							107	56	52
Precision, Error, Significant Digits									

Objective Topic	Level 5			Level 6		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Non-standard Measures	13	9	69			
English System	35	10	28	7	4	57
Metric System, including conversions	17	2	12			
Temperature	9	6	67			
Monetary System	38	17	45	9	6	67
Time and Date	38	16	42	7	5	71
Metric-Geometry, Trigonometry						
Precision, Error, Significant Digits	10	6	60			

Applications of Mathematics represents a category where mathematics skills are applied to the typical problems encountered by pupils in day-to-day living. The measures taken usually involve word problems and may be confounded by reading skills. The problems are drawn from those areas of personal business transactions, science, social studies, and so forth, which pupils would be likely to encounter in the normal pursuit of living and learning.

Objective No. 1405 Title: Applications Level: 7
The student will demonstrate his ability to solve problems in geography by selecting, from a set of printed choices, the area of a rectangular region from a given geographic map.

System: Fountain Valley Teacher Support System in Mathematics
Publisher: Richard L. Zweig Associates, Inc.

Table 9

Applications of Mathematics
Mathematics Pupils in Grades Four Through Six

	Level 2			Level 4			Level 5		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Mathematics: Numbers and Operations				6	4	67	74	32	43
Mathematics: Geometry				24	4	17	66	25	38
Business	38	17	45						

Table 10

Sets
Mathematics Pupils in Grades Four Through Six

	Level 2			Level 3			Level 4		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Identification, Membership, Notation				12	7	58			
Union, Intersection, Cross Product	30	29	97						
Solution Set for Equations and Inequalities							6	4	67

Functions and graphs, the representations of paired relationships permit learners to recognize two variables in pictorial fashion. Deriving information from graphic form at an elementary level is a prerequisite to visualizing higher order functions (quadratic, exponential, etc.) in the latter grades.

Objective No. 1704 Graphs: Picture, Bar, Circle, Line Level: 9

Given a set of compound inequalities and a set of graphs, the student will match the inequality with the appropriate graph.

System: Instructional Ojbective Exchange
Publisher: UCLA Grade School of Education

Table 11

Functions and Graphs
Mathematics Pupils in Grades Four Through Six

Objective Topic	Level 2		
	Number Failed	Number Passed	Percent Passed
Ordered Number Pairs, Relations, Graphs	16	14	88

Logical thinking, the higher order of reasoning capacities require the skills of analysis of component parts and the synthesis of solutions. Inductive reasoning (where a principle, or rule is developed from the parts) and deductive reasoning (where a known rule or principle is applied to a problem) lead to hypothesis testing and problem solving using the basic skills, especially mathematical tools.

Objective No. 1804 Deductive Reasoning Level: 4
The student will demonstrate his ability to make deductions using Venn diagrams by selecting, from a set of printed choices, the statement that expresses an accurate deduction from data shown in a Venn diagram.

System: Fountain Valley Teacher Support System in Mathematics
Publisher: Richard L. Zweig, Associates, Inc.

Table 12

Logical Thinking
Mathematics Pupils in Grades Four Through Six

Objective Topic	Level 4		
	Number Failed	Number Passed	Percent Passed
Deductive Reasoning	2	0	0

Table 13

Problem Solving
Mathematics Pupils in Grades Four Through Six

Objective Topic	Level 2			Level 4			Level 5		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Analysis of Problems				33	25	76	32	6	19
Solution of Problems	74	48	65	55	37	67	65	28	43

Participants in Grades Seven Through Nine

The most frequently selected objectives were those basic computation operations appropriate for ability level six. In addition, remedial mathematics participants continued to have difficulties with fractions, percentages, and rounding. With the exception of objectives dealing with geometric properties (in table 15) only, the computation and related objectives in table 14 received attention by more than 100 participants. The success rates of participants attempting level six objectives in the category of numbers and operations where the groups exceeded 200 ranged from 32 to 65 percent mastery across short treatments.

Table 14

Numbers and Operations
Mathematics Pupils in Grades Seven Through Nine

Objective Topic	Level 2			Level 4			Level 5		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Pre-operational Concepts: Equivalence, Equality, Order, Number, Numeral, Fewer, More, ...									
Whole numbers							121	65	54
Fractions (i.e., Positive Rational Numbers and Zero)	13	7	54	93	37	40	305	124	41
Decimals	15	5	33				212	66	31
Negative Numbers	5	3	60				9	6	67
Real Number System							7	0	0
Addition: Concepts and Skills				29	14	48			
Subtraction: Concepts and Skills				73	29	40			
Multiplication: Concepts and Skills				93	38	41	9	5	56
Division: Concepts and Skills				98	23	23	27	12	44
Properties of Operations and Relations							132	5	4
Numeration Systems									
Number Sentences	12	5	42						
Number Theory									
Estimation, Rounding	85	69	81						
Percent	15	5	33						

Table 14 (Cont'd.)

Objective Topic	Level 6			Level 7			Level 8		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Pre-operational Concepts: Equivalence, Equality, Order, Number, Numeral, Fewer, More, ...	41	29	71				21	14	67
Whole numbers	19	14	74						
Fractions (i.e., Positive Rational Numbers and Zero)	579	185	32	152	94	62	33	24	73
Decimals	29	18	62	75	28	37	4	4	100
Negative Numbers	15	6	40						
Real Number System	24	15	62	25	14	56			
Addition: Concepts and Skills	525	205	39	12	12	100			
Subtraction: Concepts and Skills	585	251	43	21	20	95			
Multiplication: Concepts and Skills	259	169	65	22	21	95			
Division: Concepts and Skills	742	309	42	32	30	94	28	20	71
Properties of Operations and Relations	32	17	53	150	78	52	18	12	67
Numeration Systems	22	7	32						
Number Sentences	7	6	86				48	46	96
Number Theory							6	4	67
Estimation, Rounding				119	65	55			
Percent	22	5	23	55	23	42			

Objective Topic	Level 9		
	Number Failed	Number Passed	Percent Passed
Pre-operational Concepts: Equivalence, Equality, Order, Number, Numeral, Fewer, More, ...			
Whole numbers	11	6	54
Fractions (i.e., Positive Rational Numbers and Zero)			
Decimals			
Negative Numbers			
Real Number System			
Addition: Concepts and Skills	12	7	58
Subtraction: Concepts and Skills			
Multiplication: Concepts and Skills			
Division: Concepts and Skills			
Properties of Operations and Relations			
Numeration Systems			
Number Sentences			
Number Theory			
Estimation, Rounding			
Percent			

Table 15

Mathematics Pupils in Grades Seven Through Nine
Geometry, Measurement, Applications

Objective Topic	Level 5			Level 7		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Parallel and Perpendicular Lines				31	26	84
Angles				50	35	70
Polygons: Triangles, Quadrilaterals, and Others				166	57	34
Metric System, including conversions	8	8	100			
Mathematics: Numbers and Operations	2	2	100			

Table 16

Mathematics Pupils in Grades Seven Through Nine
Statistics and Probability

Objective Topic	Level 5			Level 6		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Mean, Median, Mode, Range	11	11	100			
Probability: Basic Concepts and Simple Events				40	14	35

Table 17

Mathematics Pupils in Grades Seven Through Nine
Problem Solving

Objective Topic	Level 5		
	Number Failed	Number Passed	Percent Passed
Solution of Problems	5	5	100

Participants in Grades Ten Through Twelve

There were few high school pupils in remedial mathematics treatments as compared to the elementary grades enrollments. A survey of tables 18 and 19 reveals that performances level 7 objectives were those objectives most often attempted. As with the younger participants, the computation skills of division, multiplication, addition and subtraction received the greater emphasis. Pupils continued to attempt objectives with percentages, decimals and fractions. It should be noted that the larger part of this target population has been placed in grades ten through twelve but is performing at ability levels below grade eight, the conventional level of minimum competence.

Table 18

Mathematics Participants in Grades Ten Through Twelve
Numbers and Operations

Objective Topic	Level 5			Level 6			Level 7		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Whole Numbers	17	10	59	90	71	78			
Fractions (i.e.,positive rational numbers and zero)	20	6	30	30	10		44	41	93
Decimals	26	5	19				86	67	78
Real Number System							43	28	65
Addition: Concepts and Skills							92	69	75
Subtraction: Concepts and Skills							71	47	66
Multiplication:Concepts and Skills							91	57	63
Division: Concepts and Skills							134	94	70
Properties of Operations and Relations							25	23	92
Number Sentences									
Estimation, Rounding									
Percent	27	5	18				74	59	80

Objective Topic	Level 8			Level 10		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Whole Numbers						
Fractions (i.e.,positive rational numbers and zero)						
Decimals						
Real Number System						
Addition: Concepts and Skills						
Subtraction: Concepts and Skills						
Multiplication:Concepts and Skills						
Division: Concepts and Skills						
Properties of Operations and Relations						
Number Sentences	41	40	98			
Estimation, Rounding				10	2	20
Percent				10	3	30

Table 19

Mathematics Participants in Grades Ten Through Twelve
Geometry, Measurement, Sets and Problem Solving

Objective Topic	Level 3			Level 4			Level 6		
	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed	Number Failed	Number Passed	Percent Passed
Parallel and Perpendicular Lines							20	9	45
Polygons: Triangles, Quadrilaterals, and others									
Congruence, Similarity, Ratio and Proportion									
Polyhedra: Prisms, Pyramids, and others									
English System							74	38	51
Monetary System				3	3	100			
Time and Date				11	7	64			
Identification, Membership, Notation	2	2	100						
Solution Set for Equations and Inequalities									
Analysis of Problems									
Solution of Problems									

Objective Topic	Level 7		
	Number Failed	Number Passed	Percent Passed
Parallel and Perpendicular Lines			
Polygons: Triangles, Quadrilaterals, and others	77	37	48
Congruence, Similarity, Ratio and Proportion	19	8	42
Polyhedra: Prisms, Pyramids, and others	46	15	33
English System			
Monetary System			
Time and Date			
Identification, Membership, Notation			
Solution Set for Equations and Inequalities	24	13	54
Analysis of Problems	5	1	20
Solution of Problems	64	35	55